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DATAMATION®

SEPTEMBER 1, 1987
A CAHNERS PUBLICATION
INTERNATIONAL EDITION

SPECIAL
INDUSTRY-BY-INDUSTRY
REPORT

What Your Competition Spends On I.S.

105 U 1063/89
STATISTICAL REFERENCE STC042050
CONGRESSIONAL INFO SERVI
4520 EAST WEST HWY
BETHESDA MD 20814

DATAMAT

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Cover Illustration by Javier Romero

INTERNATIONAL EDITION

SEPTEMBER 1, 1987
VOLUME 33
NUMBER 17
THIS ISSUE, 190,916 COPIES

1987 JESSE H. NEAL AWARD

Editorial

Breaking Down The Great Wall

INTERNATIONAL EDITOR PAUL TATE

Although diplomatic and business channels between China and the rest of the world have grown increasingly wider in the last two decades, the country is still forbidding to multinational end users and information technology vendors trying to set up shop there. Last year, China traded $50 billion in goods and services with other countries. Yet, U.S., European, and Japanese executives forming strategies for doing business in and with the country of more than 1 billion people still view the journey ahead as difficult.

That's why DATAMATION sent international editor Paul Tate to China in the early summer. Tate finds that the Asian giant's efforts to use information technology to build a modern economy and to support a massive expansion in international trade is going in slow motion. "For international companies, especially those selling technology-based services or technology products, it makes doing business with China as complicated as a Chinese puzzle," Tate reports. Chinese authorities, he discovers, are doing everything possible to make the puzzle less complicated. The exclusive Behind the News report, "Dateline Beijing: The China Syndrome" (p. 33), we believe, contributes to that effort.

On his return from China to his London base, Tate stopped off in Japan long enough to give Tokyo bureau manager Robert Poe a hand at compiling our annual ranking of the top 10 information systems companies doing business in Japan ("Living with the High Yen," p. 92). The pair analyze the impact of the appreciation of the Japanese yen against the U.S. dollar, discerning that the shift dampened the bottom lines of IS suppliers far more than the appetite of Japanese customers for computers and communications equipment.

Tate has returned to London and his usual beat managing DATAMATION's international coverage, while Poe continues to monitor developments in the Pacific Rim.

Tim Mead

TIM MEAD
EDITOR-IN-CHIEF

Behind the News

SPECIAL REPORT

WELCOME TO GOLDEN SHOPPING CENTRE
THE WIDEST CHOICE OF COMPUTERS IN
ASIA WITH OVER 120 SHOPS AT THE
MOST COMPETITIVE PRICES
GW GOOD WORLD COMPU
Great Wall
CC200

Dateline Beijing: The China Syndrome

China has set out on perhaps its most important revolution—implementing computer technology in what is still a largely agrarian economy.

BY PAUL TATE AND JOHN H. MAIER

During an exclusive interview with DATAMATION in Beijing, Prof. Hu Qiheng, the president of the Chinese Computer Federation, explained, "Closing the gap between China's hopes for using computers in the modernization of the economy, and what is really happening, is the task we are working on day and night" (see "Closing the Gap"). That's welcome news for the huge number of ambitious international companies attracted by China's wealth of natural resources, its market of 1.1 billion people, and its quickening move from Marxism to marketing.

Last year, those companies engaged in $50 billion worth of trade with China; that total is predicted to hit $75 billion by 1990. The growth in trade may rise even faster following the recommendations of a recent congressional Office of Technology Assessment report, *Technology Transfer to China*, and the imminent changes to U.S. laws concerning exports to China (see "A Brighter Shade of Green"). What eager companies don't find out until they start dealing with China, however, is that overestimating the business environment, and underestimating the Chinese people, can prove to be commercial suicide. "You can't simply implement the normal standard of corporate systems here, however much your business depends on it," points out Guenter Szwoch, manager of Siemens' communications and information systems group in the main China office. "For any commercial application, people's experience and thinking does not go beyond the level of the IBM PC."

Setting up operations in China is particularly difficult for the information systems departments of foreign companies. Trained computer personnel in China are few due to the country's lack of foreign funds to buy appropriate hardware and software. In addition, there is virtually no networking, the electric power supply is erratic, and, most important, the lack of applications knowledge precludes most efforts to create effective systems. It is that systems gap, more than almost any other element, that is helping to keep China's bureaucracies big, as well as limiting economic growth and hindering international trade.

Computers Key to Modernization Policy

The Chinese government, under the reforming leadership of Deng Xiaoping and premier Zhao Ziyang, is pushing ahead with its plan to modernize four key areas: industry, agriculture, the military, and science and technology. This plan was adopted as a national policy in 1978. Speaking at the Second International Conference on Computers and Applications, held in Beijing in late June, the head of the China State Council's Committee for Electronics Innovation, Li Xiang-Lin, told delegates that the coun-

Illustration by Jane Sterrett

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try "regards computers as one of the key development objectives." The hope is that the use of computers can aid the transformation of the country from a largely agrarian and local craft-based society into a major world economic power in the twenty-first century.

Li Xiang-Lin estimates that by the end of 1986, China had an installed base of 8,000 minicomputers and mainframes, and over 200,000 micros. The number of LANs is still low, but it's growing rapidly. There are currently over 170,000 computer professionals in China, half of whom are involved in developing new applications. So far, Li estimates, systems have been developed covering 20,000 application program areas.

According to a 1986 report from the U.S. embassy in China, over 60% of the computers in China are used in transportation and industry, 17% in science and education, and only 3.4% in commerce and finance. The remainder is spread thinly in the cultural, health, and agricultural areas, as well as other sectors.

More significantly, the report suggests that one major reason for China's lack of widespread automation is gross underutilization of the systems the Chinese already have. "China could virtually double its computer processing by better training of its operators and the purchase and development of advanced software already available in the West," says the report. That may be underestimating the problem. Many people working in the information systems sector in China, including the Chinese, suggest that computers are being used at between only 15% and 25% of capacity.

The Role of Foreign Vendors

Much of the technology underlying those statistics has come from foreign firms—in the U.S., Japan, and Europe, (see "China's Computer Imports"). Over the last 10 years, China has imported an estimated $2 billion of foreign information technology. IBM, Digital Equipment Corp., Hewlett-Packard, Unisys, Fujitsu, Honeywell Bull, and Siemens have all had their share of those deals.

IBM regards its growing business in China with such seriousness that it set up an IBM China Corp. in Hong Kong in 1984. According to a statement from the IBM China office, "IBM's business in China is still very young. It is a very challenging environment, and we are still learning more about it every day."

Siemens is more forthright. "If you look at the world map and ask where are the areas of opportunity, then China is the biggest," says Szwoch. "Whether it will become a computerized society in 10 or 20 years I don't know, but if we're not here and it does, then we will have missed the boat."

One of the limiting factors to technology trade now is the shortage of foreign reserves available for foreign purchases. This is largely the result of overzealous expenditures during the first few years of the open door policy. A Chinese manager who was given a budget to im-

Closing the Gap

PROF. HU QIHENG

In an exclusive interview with DATAMATION in Beijing, Prof. Hu Qiheng, the president of the Chinese Computer Federation (CCF), detailed China's next moves.

Prof. Hu is among China's leading computer professionals. Born in 1934 and educated at the Moscow Chemical Mechanics College when China and the USSR were still close, she has worked on both process control and computer systems during her career. She now holds key positions within the Chinese scientific community. She is the founding president of the CCF, which was set up in 1985, and is also the deputy secretary general of the Chinese Academy of Sciences, the president of the Chinese Association of Automation, and a council member of the International Association of Pattern Recognition.

Her understanding of the underlying issues involved in China's computerization is clear. "The problem [of modernization] goes very deep into our culture," she explains. "It is a problem that results from the enormous size of our country and our organizational structure. This involves many unreasonable processes, and we must reform these processes. If we do not, then computerization will not be effective. You cannot just take the way we do things today and add a computer. That will not help. We must encourage political reform, then economic reform so that we can make the best use of computers."

She is also aware of the shortcomings in China's development of key application systems. "There are not many computers being used in the office and administration side of our country," she confirms. "This is the least effective area of application at the moment. In industry and science, computer use is much better."

The solution, she believes, is to "teach our people more about systems analysis, more about what computers can be used for."

The CCF takes an active role in this educational effort. It is made up of 24,000 members throughout China and is linked to local societies in 28 provinces. More important, it cuts across the traditional hierarchical structure of Chinese organizations. The CCF runs about 40 conferences a year, acts as a technical and high-level strategy consultancy for Chinese organizations, holds computer training courses for department heads in different industry sectors, and, through the use of the broadcast and publishing media, works to popularize computing with the Chinese people.

The efforts to expand computer use are limited by the scarcity of appropriate hardware and software in the country. Importing technologies to solve the problem isn't easy, however. "Money is in short supply for us, and we must establish a balance of trade with the West," says Prof. Hu.

She therefore believes that China must adopt a two-tier strategy for the future. "It is important that we buy systems and software that will help us to reform effectively," states Hu. "We must also be able to use our existing systems more effectively."

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port Western technology would spend it on anything rather than give a cent of it back. They weren't prepared for the consequences.

"They were not aware of the enormous investment needed to get the right software and to implement a system," comments Siemens' Szwoch. "There's some magnificent equipment here that isn't being used. Millions of dollars of equipment. In the past, they got skinned, and they'll be more careful about what they buy in the future. They have learned the bitter lessons. Now they are overcareful. We have to regain their trust."

For a while, the Chinese thought that modernization meant having the right machines. Now they are learning that it is a systems game. China's guidelines for technology acquisition reflect the country's change of emphasis; systems must be above the level available in China, must be of practical use, must contribute to China's eventual self-sufficiency, must foster economic and social development, and must be useful for generating foreign exchange.

Not all of China's technology comes from abroad. It has its own computer traditions (see "The Long March") and is actively creating an internal computer industry, centered in Beijing and in Shanghai, much of it under the control of the newly formed China Computer Development Corp. (CCDC).

Set up in early 1987, the CCDC's stated aim is to become "China's IBM." It pulls together many of the disparate computer development and manufacturing facilities in China into one organization. The aim is to coordinate the country's production of machines and help ensure that the people with talent are given the right environment to work in. Cutting across the traditional hierarchies of Chinese state-controlled organizations is essential if this is going to be effective.

Thirteen factories that build the Great Wall microcomputer are part of the CCDC. Together, they produce 25,000 pcs a year. Factory Number 3, in Beijing, manufactured minis from 1965 until 1983, when it began producing 8-bit machines. Now it sells the IBM-compatible Great Wall, which it builds using Intel microprocessors and memory chips from Oki of Japan. It also makes a Motorola 68000 multiuser Unix system called the BCMS 68000. "What we would like to do is to make Digital's MicroVAX here," says Pan Tianbao, deputy chief of production at the plant.

FIGURE 1 China's Increasing Computer Imports*

(IN $ MILLIONS)

COUNTRY	1983	1984	1985	1986
France	5.8	1.6	2.8	9.2
West Germany	1.3	7.3	7.1	11.1
Italy	0.4	0.8	1.1	1.2
U.K.	2.3	4.0	6.0	4.3
Japan	25.7	49.9	83.7	84.9
U.S.	35.3	77.6	154.7	189.7
Total	70.8	141.2	255.4	300.4

*All figures include computer systems, cpus, and peripherals.

Source: Official Customs Statistics

The Long March

The first Chinese computer was completed in 1958, two years after the establishment of the Beijing Institute of Computer Technology (ICT) by the Chinese Academy of Sciences. The vacuum tube-based machine, called the Model 103, was not sophisticated, and was probably built with the help of Soviet technicians.

In 1960, the Soviet Union withdrew all of its technical aid from China. For the next two decades, computer development was solely in Chinese hands.

China's two second generation machines were announced in 1965. ICT developed a 32-bit computer called the Model 109B, while a much slower, 21-bit machine was produced by the Beijing Telecommunications Factory. Both of these were only laboratory models and never went into production.

In 1966, a massive blow to China's scientific development occurred—Mao's Cultural Revolution. While scientists in the West were building a computer industry, Chinese universities were shut down for almost 10 years. Scientists and the intelligentsia were forced to work in the fields and were hounded by the Red Guards.

Some development was protected, however, and IC-based machines built by researchers in Beijing and Shanghai began to emerge in the early '70s. However, China's various computer developers pursued extreme independence in those early years, producing 21-, 32-, 36-, 39-, 42-, 44-, and 48-bit architectures. These were mostly incompatible with international trends—and with each other.

More important, there was no successful, widespread penetration and diffusion of the technology into China's vast economy and society.

The turning point for China came in 1978 when a National Science Conference proclaimed that China's future modernization would be science driven and no longer ideology driven. Improvements in computing were identified as a high-priority national goal. China opened its doors to the West, and the result over the last 10 years has been substantial growth in Chinese computer development.

While China has imported more than 1,500 mainframes and minicomputers, and more than 150,000 micros since then, it is establishing its own industry. The Chinese, apart from setting up or expanding manufacturing plants to produce minis and micros, have also grappled with the problem of automating the ideographic Chinese language. In addition, they recently announced a 10MIPS array processor and a 100MIPS supercomputer called the Galaxy—or, translated literally, the River of Stars. The supercomputer project is a good example of the strategies and setbacks in Chinese computer development today. Though it is an ambitious system and was designed by the Chinese, it uses imported components. Reports in Beijing indicate that its performance is not very dependable.

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There are now an estimated 2,600 joint ventures between Chinese organizations and foreign firms. Though not all have been successful, many foreign computer firms are looking for a stake in one particular joint venture: to build a mainframe assembly plant in China. The chances are that the company that wins the deal will also win a massive share of China's growing mainframe market.

Naturally, IBM is interested. "We have been holding discussions regularly with the Chinese authorities on the possibility of cooperative projects," states an IBM China spokesman. Also in the running, according to local speculation, are China's other main suppliers: Unisys, Hitachi, Siemens, and perhaps Digital.

Installing the systems after they are made is another story. Jacques Witasse, corporate marketing manager for Honeywell Bull's new DPS 7000 range of systems, was running seminars in Beijing for Chinese users in June. He remarks, "There's nowhere in the world like this because they don't use computers the same way we do. Applications are almost exclusively scientific and numeric. When it comes to the automation of administrative tasks and offices, they don't do it. The networking side is also very difficult here because the communication system is so basic. I don't expect our machines to be used the same way here as anywhere else. They don't know what transaction processing is—and that's going to be the key."

The lack of networking hinders computer users in China in other ways. "Remote diagnostics simply isn't possible here," says Siemens' Szwoch. "Users have to wait until an engineer can get to them when there's a problem."

Thirteen factories produce the Great Wall pc.

Improvements to China's networking ability are in the early stages (see "Networks to Come"). On the applications side, though, there already are examples of the way ahead for China.

In the buildings of the Municipal Government of Nanjing in the Jiang-su province is one of China's more sophisticated information systems. The main application is office automation and it supports Chinese character electronic mail, Chinese word processing, and a data-based management information system. Twenty people can use the system at any time via terminals and a fiber-optic LAN.

One of the system's developers, Xue Xing, a PhD student at Nanjing University, explains that they had to start

Networks to Come

China's computer networking plans, first announced in 1978, are now well behind schedule. Although there are an increasing number of local area networks in operation, very few computer users have ever come across wide area networking. The wide area links that do exist can be found either on the basic internal nets run by the rail, airline, and military sectors, or on the few leased-line connections from the offices of foreign companies to satellite earth stations.

All this is about to change, and the scientific community is taking the lead. China has made an official application to join Bitnet, the academic and research network that now includes over 200 member institutions in 17 countries. The plan is to make the first network broadcast from China on Oct. 1, 1987, and, by June 1988, to have linked 17 Chinese nodes via a prototype national research net called Chinanet. This will provide a long overdue practical example of national and international networking.

Setting it up, however, won't be easy. The main problem with networking in the country is the notoriously bad telecommunications system. Today, almost 10 years after China began its technological revolution, only one in 200 Chinese people have a telephone—one of the lowest telephone densities in the world. What's more, most networks are still unreliable, and getting a good line, even within some of the major cities, is fraught with delays, misrouting, and operator interventions.

Combine that with a lack of trained networking personnel and a scarcity of networking equipment, and it is obvious that China still has a long way to go.

There have been some improvements, however. China's telecom inventory now includes an expanding microwave network between 17 major cities; two Chinese communications satellites (successfully providing voice, data, and video service, according to the Chinese, though still experimental and with limited transponder capacity); several leased Intelsat transponders for domestic use, with a footprint covering all of China; a sparse national twisted wire infrastructure; and some special point-to-point links, including a coastal cable. In addition, China has installed 53 transmit/receive satellite earth stations and approximately 2,000 receive-only earth stations. China is also moving ahead with the use of fiber-optic technology, and that, combined with a satellite strategy, could eventually solve many of the country's network problems.

With demand for telecom services by Chinese and foreign companies now increasing rapidly (in mid-1986, there were 100,000 organizations waiting for communications links in the country, and that's only the beginning), China has become a suppliers' market for international telecom companies. For example, Belgium ITT, now merged into the new Alcatel group, has a $350 million joint venture in China to manufacture stored program control switches, while Japan's Fujitsu signed a $3.5 million deal in June with China's Fujian province to establish a joint software development center for digital switching systems.

Meanwhile, the Chinese network team, led by Prof. Qian Shixiang, chairman of the computer sciences department of the Beijing Institute of Aeronautics and Astronautics (BIAA), hopes to complete the initial Beijing branch of Chinanet this year using a local, dedicated fiber-optic network in the Haidan Qu district of the city. This will connect the BIAA, Beijing University, Qinghua University (China's equivalent of MIT), the Institute of Computing Technology of the Chinese Academy of Sciences, and perhaps other institutes in the area. During early 1988, this will be connected via 17 nodes across China to other universities and institutes.

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from scratch. "There are not many systems using this type of application, but it is an area that is growing very fast," according to Xue. "The trouble is getting the money to develop and install them."

Access to more advanced software tools would help cut the cost of development, and that is the goal of China's national software engineering program. Run by Bosheng Zhan, associate professor and vice chairman of the computer science department of the Beijing Institute of Aeronautics and Astronautics, the program is sponsored by China's State Science and Technology Commission and involves researchers in 13 Chinese universities and institutes. The program's review committee, however, is not Chinese. It is made up of experts from the University of Maryland, College Park. The software engineering environment they are developing is based on Unix and written in C. "We think that some of our tools are better than anything in the U.S., and we would like to sell the ideas outside of China," says Bosheng.

A Base for Developing Applications

Complex software problems already have been overcome in China, particularly those connected with the major task of automating China's ideographic language—there are over 400 different Chinese character entry processing systems to choose from.

Now that the language has been automated with some degree of success, there is a base for developing administrative and office applications. Though the expertise needed to create effective systems is limited, this will change as the many Chinese students in the U.S., Europe, and other Asian countries—around 30,000 in 1986—return home after being exposed to Western management methods and techniques of systems analysis. Probably the most influence on the future of China's information systems development will come from foreign companies. They will set examples, make money, and, if they want to maintain and expand their systems in China, they will probably transfer some of their know-how to their trading partners.

Both the outside companies and the Chinese are becoming aware that they have to make realistic plans to account for limitations in the use of information systems as a base for business. China, meanwhile, is beginning to focus on closing its applications gap.

If international trade is supposed to be a process of mutual benefit, then trade with China will have to be a process of mutual education for a few years. "And then," as Prof. Hu puts it, "once the friendship has been established, the world will seem a smaller place." ■

Paul Tate is DATAMATION's international editor. John H. Maier is an independent computer and networking consultant in Fort Worth. He has been involved with Chinese computing for eight years and has recently spent a year lecturing in China on the computer sciences.

A Brighter Shade of Green

China has been off the export hit list since 1983, when it was transferred to country group "V" under the U.S. Export Administration Act. The green zone was added to the Commodity Control List that same year. The list determines what number of products can be sent to a country under what type of export license. The green zone demarcates items likely to be approved for export.

Among the green zone's original seven listings were semiconductor production equipment, computers, and computerized test equipment. The zone was expanded to 27 commodities in 1985 by the Coordinating Committee for Multilateral Export Controls (Cocom), which includes the NATO countries and Japan. Thus, technology within the new limits could be shipped to China at the exporting country's discretion, without preexport Cocom review.

Now, the green zone's grown again. The Department of Commerce's (DOC) latest guidelines expand to 285 from 155 the processing data rate (PDR, a measurement of computer performance) for machines sent to China. The guidelines, which had allowed disk drives to be exported disassembled, now allow assembled drives to be sent to China.

"I think Commerce finally recognized that U.S. companies need these kinds of guidelines to compete against the West European companies that have less stringent export controls," says Kelly Shea, a high-tech analyst at the National Council for U.S.-China Trade. The group of about 350 companies, including IBM, Digital Equipment Corp., Hewlett-Packard, and NCR, had recommended to Congress a further widening of the green zone to a PDR of 300.

According to the congressional Office of Technology Assessment's (OTA) report "Technology Transfer to China," 134 China applications valued at $145 million had been in the export pipeline for more than a year as of January 1987. While average processing for China cases had declined to 57 days in April, the processing time for referred China cases (those reviewed by agencies in addition to DOC) continues to take an average of almost six months.

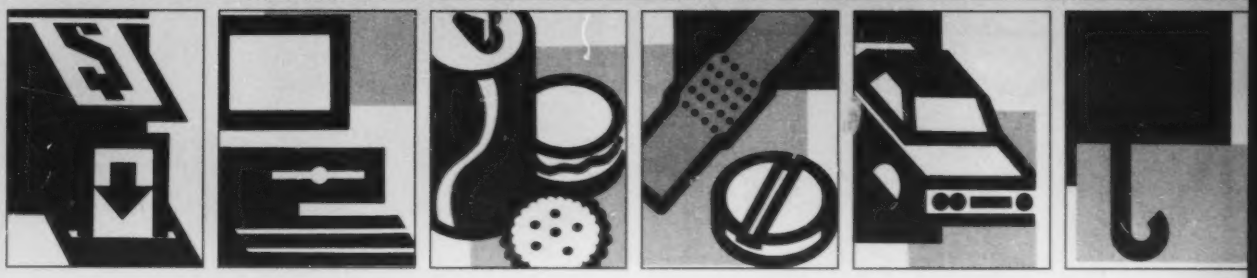
"OTA's research confirmed that other countries are generally able to reach a decision on even sophisticated dual-use exports in a few weeks," the report says, "while the U.S. frequently requires months or even years. In addition, only the U.S. unilaterally imposes controls on items not on the list of Cocom-controlled items, and requires that exports to allied countries, if reexported to third countries, be again subject to the original licensing. The latter requirement has caused considerable discord between the U.S. and other Cocom members."

According to OTA, computing equipment alone made up almost 80% of the value of 1986 export licenses approved to China. So while U.S. controls aren't the critical factor determining the overall volume of trade with China, they don't exactly help China get what it wants when it wants it.

Expanding the green zone is a start. But OTA suggests Congress not stop there. It recommends a six-day licensing policy for green zone cases; giving DOC the authority to approve licenses unless formally appealed to the President, with an automatic approval of cases that have been held up for too long; developing plans to enlarge the green zone; and ensuring that U.S. controls are in line with Cocom allies, even if that means dropping unilateral controls.

Should all this come to pass, it still doesn't guarantee a run on licenses by the computer industry. The desire to export "all depends on the company," says Jim LeMunyon, senior manager of government relations for the American Electronics Association. "And the new green zone combined with the OTA report should make it easier for U.S. companies to compete."

BY WILLIE SCHATZ



Industry by Industry IS Survey

The late senator from Illinois, Everett Dirksen, once said, "A billion here, a billion there, pretty soon it adds up to real money." We studied information systems spending at 120 of America's largest companies, industry by industry, and discovered that, indeed, we're talking real money, an average of just under 2% of total corporate revenues. Here's how IS is allocating its resources in a dozen industries.

A DATAMATION REPORT

The enterprises DATAMATION surveyed had an aggregate revenue of $1.5 trillion during the last fiscal year, which comes to something like a third of the U.S. gross national product. The total information systems expenditures made by these 120 giants of industry and commerce amounts to about 2% of their revenue as a whole. This works out to more than $27 billion, a sum that is in excess of the gross domestic product of New Zealand. Last year, about $9 billion of this was spent on hardware alone. A larger amount, $13 billion, was allocated to personnel expenses. Smaller portions of the total went for software ($2.5 billion) and overhead ($2.7 billion).

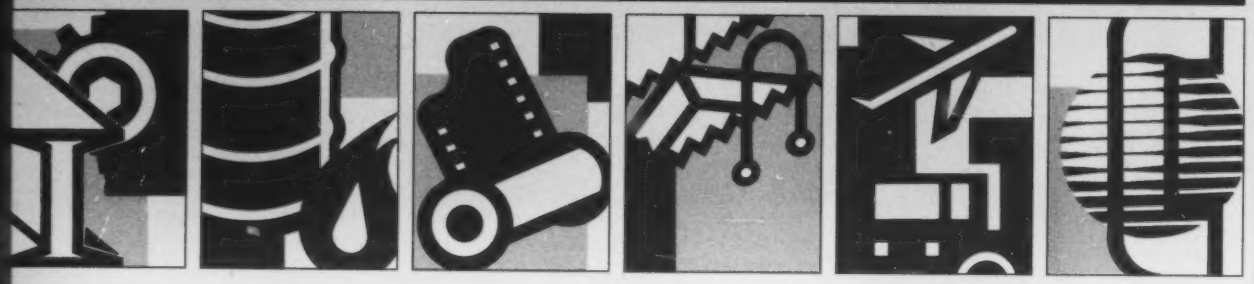
This year, IS budgets for individual companies will rise by anywhere from 3% to 20%, and total information systems expenditures will approach or surpass $30 billion. If the economy stays on track, the prospects for 1988 are even brighter.

Among fast-growing companies, the share of revenue going to information systems may decline this year compared with last, but many of the top computing executives indicate that their expenditures during 1987 are still subject to change. Because many of these users make significant hardware purchases late in the calendar year—as reflected in the revenue patterns of the computer industry's vendors—the actual totals for 1987 can't be known until the user organizations wind up this year's accounting work in the early spring.

Despite the enormity of these amounts, IS budgets substantially understate the actual computing expenditures within most companies. The chieftains of DATAMATION's top shops indicate that their companies spend considerable sums on computerization in addition to the specifically budgeted amounts. While the off-budget computing expenditures at some companies are insignificant, most information systems directors we queried estimate that their coworkers are independently spending sums equal to 5% to 50% of IS's budgeted total. In a few cases, information systems executives say that expenditures outside their corporate IS budgets may equal or exceed budgeted funds. For such companies—e.g., holding companies or certain franchisers—the corporate IS budget is really not a valid consolidated item, the way it is at a fiscally integrated enterprise.

The pattern of expenditures varies among the industry groups, as does the portion of corporate revenue that is allo-

Illustrations by Javier Romero



cated to IS departments. Companies that are mainly processors of information—banks, for instance—spend a greater share of income on computers than enterprises with huge plants and enormous raw material requirements, such as petrochemical outfits. Within the budgets of each group, the differences in the way funds are allocated—software versus personnel, or hardware versus software—reflect industry and corporate traditions. In some cases, the allocations are affected by what's available from hardware and software vendors.

Many users say they would prefer to use canned, standardized software, but they maintain that the packages on the market simply don't meet their requirements. These users spend money on personnel that might otherwise go to a software house with the right product. For some applications, the computer industry has made it cheaper to add MIPS than to add efficient programs. In other cases, such as applications where only special purpose number crunchers can do the job quickly, users have little choice but to go with exotic, and often costly, hardware. As a result, users with extensive algebraic workloads may spend more on hardware and less on software, compared with the national average.

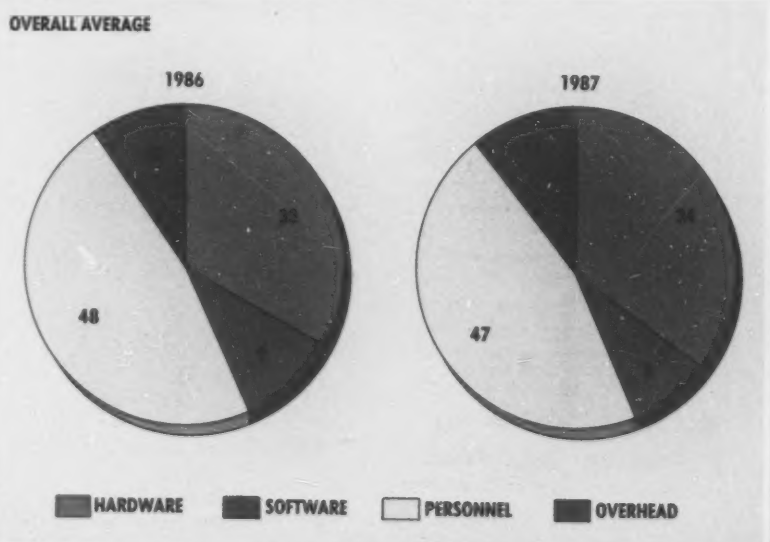
Despite all the difficulties faced by top shop managers as they try to cope with their dynamic departments, the results of this survey indicate that they are doing well. Common patterns within industry groups and even across group boundaries show that there are indeed norms. And despite the constant discussion among users about the perennial problems of computing, the leading IS executives generally report that they are satisfied with the results they are getting. More important, they indicate that their companies are also generally satisfied with the way their computing operations perform. ■

Industry by Industry Budget Summary

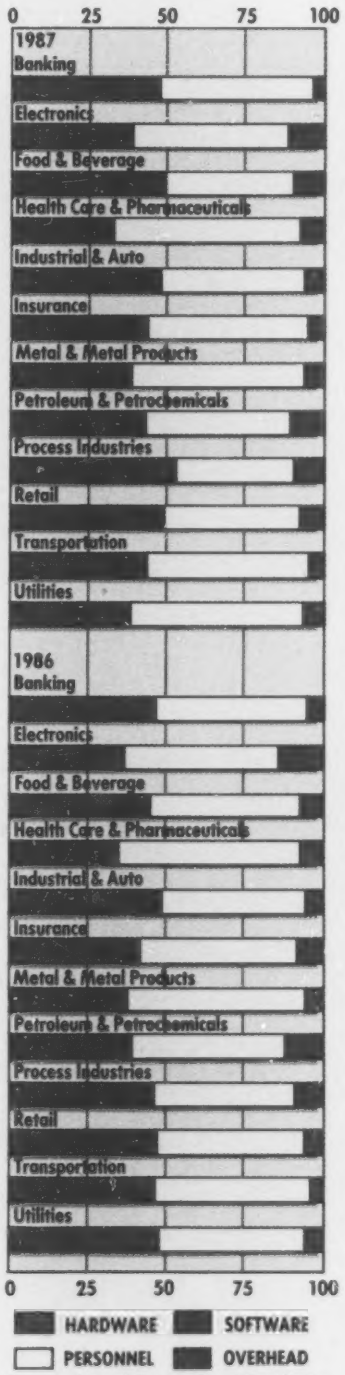
INDUSTRY	IS AS % OF REVENUE	IS BUDGET	REVENUE	PROFIT
Banking & Finance	4.5	$ 3,904.4	$ 86,968.2	$ 4,867.4
Electronics	3.7	4,839.8	131,274.4	8,121.4
Food & Beverage	1.6	1,657.1	104,334.3	6,282.8
Health Care & Pharmaceuticals	0.6	270.6	48,789.5	4,043.6
Industrial & Automotive	2.7	7,432.4	273,394.5	10,490.5
Insurance	1.7	1,678.5	100,115.5	5,182.4
Metal & Metal Products	1.1	495.0	45,083.3	–1,572.7
Petroleum & Petrochemicals	1.3	3,312.3	261,975.1	10,324.1
Process Industries	1.6	1,572.8	99,029.9	5,167.7
Retail	0.2	327.7	167,211.4	3,917.9
Transportation	1.3	712.7	54,994.5	89.5
Utilities	1.0	1,189.0	121,687.4	10,172.5
Totals	1.8	27,392.3	1,494,858.0	67,087.1

All dollar amounts are in millions.

Distribution of IS Funds by Percent



How They Spent



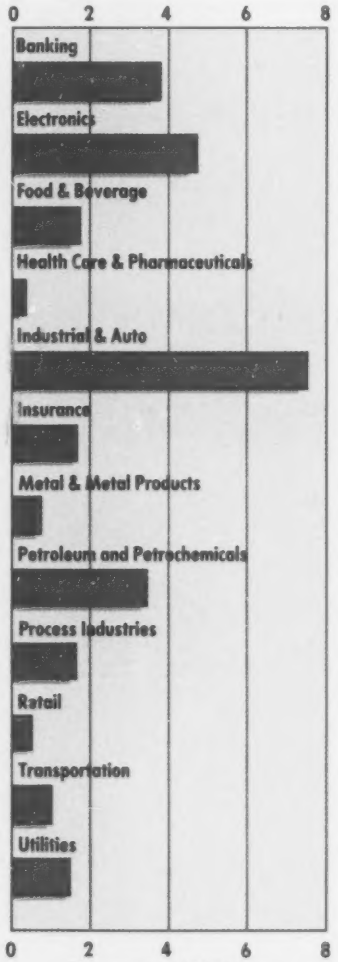
A comparison of the top shops' distribution of their budgets, by percent.

How to Read the Charts

Data in these graphs and tables reflect aggregate expenditures for the companies in each industry group. The data are presented in two ways. First, the groups are compared by aggregate information systems budgets and by average computing intensity. Computing intensity is the percentage of revenue devoted to budgeted IS (not including estimates of off-budget expenditures). Second, each sector's budget breakdown is presented in tabular and graphic form.

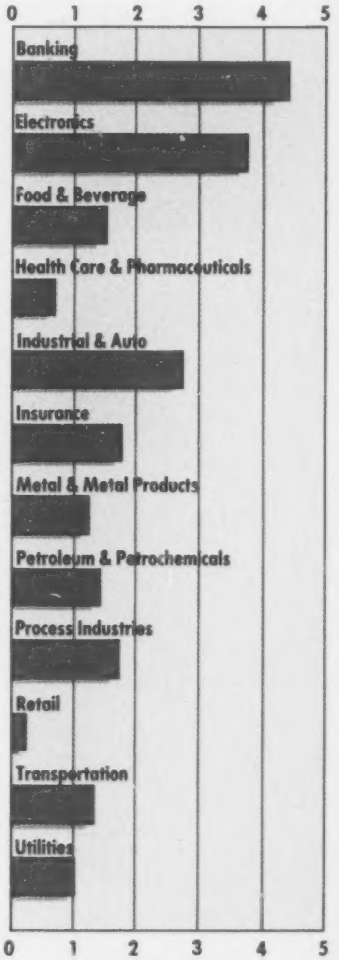
The table for each sector shows the companies in each group, their computing intensity, their size, their profits, and their accounting years. The computing intensity icon shows how each company in a group compares to others within that group. An equal sign (=) indicates that a company spends about the same percentage of its revenue on information systems as the mean for its group. A plus sign (+) means that a company spends a significantly larger proportion of its revenue on IS. A minus sign— means that a company spends a significantly smaller percentage of its revenue on information systems.

What They Paid



The aggregate IS budgets, in billions of dollars.

IS's Cut



The top shops' budgets as a percentage of their companies' revenues.

Money Is Information

Banks these days seem like giant computer systems. Automated teller machines (ATMs) take in deposits and dispense cash. Human tellers are often operators of complex workstations. Even less visible bank activities, like the management and trading of financial instruments, require computer technology. Little wonder, then, that banks proportionally spend more than twice the national average on information systems. Nonbanking financial companies, such as brokerage houses, similarly use high levels of automation to create and deliver their services.

In the banking and financial community, computer budgets are proportionally larger at the shops that provide a greater number of financial products to a large customer base. Banks that rely heavily on retail operations use more computing than their merchant banking counterparts.

In New York City, where Citicorp makes its headquarters, the megabank's ATMs seem as common as telephone booths. This huge bank is also a major provider of consumer credit services, a business that means processing mountains of paper. Its facilities range from an ATM around the corner from Manhattan's Dakota apartment building to an enormous charge card complex in Sioux Falls, South Dakota.

By contrast, J.P. Morgan, the bankers' bank, is a relatively light computer user, with far fewer customers but much larger typical transactions in its substantial business. If this institution's clients would let it round off after three digits, it might be able to manage its $7 billion books on a couple of pcs. But even Morgan's relatively lean annual IS budget is in the tens of millions.

A similar pattern of computing can be found among stockbrokers. Merrill Lynch is not only the largest company on Wall Street, but one of the most sophisticated when it comes to computing. The firm's retail side provides on-line services to thousands of sales personnel serving millions of investors. In addition, the computers for Merrill's retail operations must maintain the records and print the reports that clients and government agencies require.

There is also an institutional side to Merrill. At the firm's Capital Markets operation, giant mainframes running APL are used for programmed trading applications developed by so-called rocket scientists, in much the same way as humble pcs are pounded by Lotus-loving bean counters.

By contrast, Salomon Brothers' clientele is primarily institutional. Because Salomon does not have to provide computer support for a myriad of individual investors, as does Merrill, its computing budget is perceptibly smaller.

Far less computer intensive is Fannie Mae, the Federal National Mortgage Association, which deals with one genre of financial instrument and does not have to link its executives with the world's markets in stocks, bonds, commodities, and currencies.

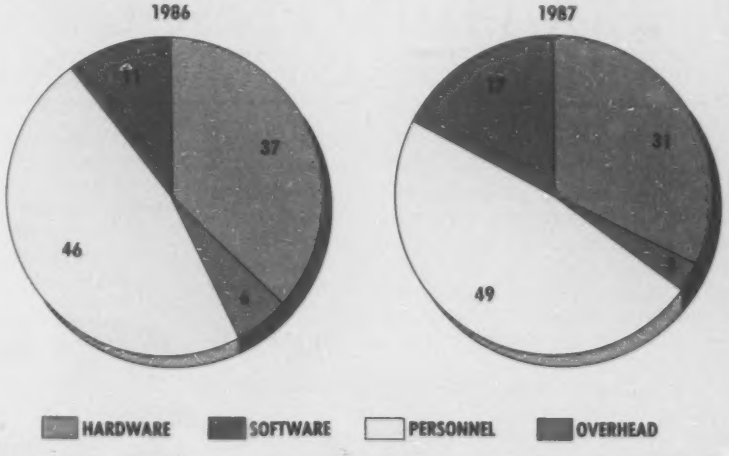
The Top 10

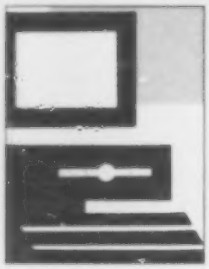
COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
American Express Co.	=	14,652	1,110	Dec. 31
Federal National Mortgage Assn.	–	10,540	183	Dec. 31
Citicorp	+	10,400	1,058	Dec. 31
BankAmerica Corp.	=	10,131	-518	Dec. 31
Merrill Lynch & Co. Inc.	+	9,606	469	Dec. 31
Manufacturers Hanover Corp.	=	7,965	411	Dec. 31
Salomon Brothers Inc.	–	6,789	516	Dec. 31
J.P. Morgan & Co. Inc.	–	6,672	873	Dec. 31
First Interstate Bancorp.	=	5,290	338	Dec. 31
Bankers Trust New York Corp.	+	4,923	428	Dec. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

Banking and finance are the most IS-intensive sectors of U.S. business, with average information systems spending using about 4.5% of revenues.





ELECTRONICS

The Vendor Is a Consumer

The electronics business not only dishes out computers—it takes them, too. With an aggregate information systems budget of nearly $5 billion during the most recent fiscal year, the leading companies in this sector have put their own products to wide use. The electronics industry is one that is continually developing new applications and customizing existing ones. So it is no wonder that, compared with the national average of top IS operations, this sector has lower software costs and higher personnel costs, due to the man-hours required for applications development. The proprietary circuit design and simulation programs that characterize this business may also account for some of the differences from the national norms displayed by this sector. Other factors that affect IS budgets are the relatively high salaries and expensive facilities that are typical of high-tech manufacturers.

Executives at the top companies in electronics say there can be wide fluctuations in their IS budgets from year to year. Their shops grow in spurts as whole new systems are brought up to handle new applications. In addition, as engineering departments' computers are linked into enterprisewide networks that can store databases, the budgets of IS directors will grow, while off-budget expenditures will be pared down.

The biggest spender in the group—proportionally, as well as in terms of total expenditures—is also the biggest company, IBM. Increasingly, IBM has added databases and interactive facilities to support its marketing, planning, and service groups. As the number of installed IBM products has burgeoned with the workstation market, the company's record-keeping burden has increased substantially. In addition, IBM has pushed out the frontiers of its business by ramping up semiconductor production, adding numerous software products, and accelerating the pace at which it produces, catalogs, and distributes information within its empire. IBM's top executives have stated that they are increasing their ability to monitor and control costs, and that of course means more and more information systems.

A much smaller portion of revenue goes to information systems in companies like Control Data Corp., which is far from a pure electronics producer. Many of CDC's diverse operations resemble those of other nonelectronic manufacturers. Unlike IBM, which obtains the majority of its income from direct sales, CDC gets a very large chunk of its revenue from goods that are sold in large lots to distributors. CDC also receives substantial revenue from the services sector. Nevertheless, Control Data, like all the companies in this sector, is a big computer user by national standards; its classification as a low-intensity shop really reflects its place among a group of technologically sophisticated users. Between CDC and IBM lies Intel, not only the supplier of cpus for a majority of the world's microcomputers, but a substantial computer user in its own right.

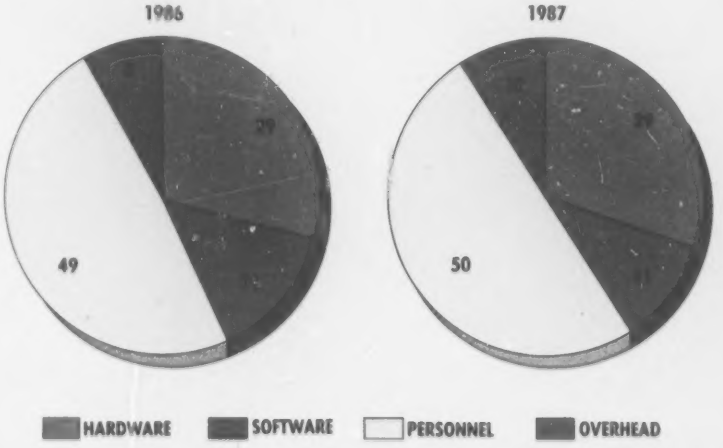
The Top 10

COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
IBM	+	51,250	4,789	Dec. 31
General Electric Co.	=	36,725	2,492	Dec. 31
Xerox Corp.	–	9,781	487	Dec. 31
Digital Equipment Corp.	=	7,590	617	June 28
Unisys Corp.	=	7,433	–43	Dec. 31
Hewlett-Packard Co.	=	7,102	516	Oct. 31
Honeywell Inc.	=	5,378	–398	Dec. 31
Control Data Corp.	–	3,347	–265	Dec. 31
Square D Co.	–	1,403	99	Dec. 31
Intel Corp.	=	1,265	–73	Dec. 26

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

While the electronics sector comes in second in average percent of revenues devoted to IS, one company spends more than 6.6% of revenues on IS.



FOOD & BEVERAGE

Bread and Butter Users

Somewhat below the national norms for information systems intensity set by the top IS shops, food and beverage companies are more conventional users of computers, with annual expenditures of $1.7 billion. In addition to bread-and-butter applications, America's largest purveyors of edibles and quaffables use computers to analyze the sales patterns of their myriad brands, sometimes on a daily basis. They manage complex inventory problems, often involving perishable products. Many also provide inventory support and advice to their distributors and largest retailers, although they lag behind the leading pharmaceuticals suppliers in this emerging application.

While these companies expect some expansion of their computing requirements as they bring in new applications aimed at streamlining the exchange of information and increasing inventory turnover, much of the need for additional computing will come about as a by-product of normal business growth. The largest companies in this group are also involved in nonfood businesses; this affects the size and nature of their computing departments.

Philip Morris Inc. is more than half again as large as its nearest competitor in the field, Nabisco Brands Inc. Nabisco is half again as large as the number three company, PepsiCo Inc. PepsiCo, however, is the most intensive computer user in the group. This may be due to the company's financial orientation. In the past, PepsiCo has been deeply involved in leasing and related endeavors, and the company still has a whole division to manage pension funds. At the low end of this group's computer intensity scale is American Brands Inc. But today's low-intensity user may be a big player tomorrow, for food and beverage companies have exhibited big appetites for new acquisitions. The practice at these companies of buying and selling whole businesses shapes the role of their star computer jocks.

When food and beverage companies diversify, their computing requirements are inevitably shaped by the enterprises they acquire. These days, tobacco barons own insurers, soda pop's pashas control fast-food chains, cereal kings sell tires. It is clear that the more diverse these companies become, the more they will depend on information technology to compare the apples and oranges they sell and the more they will resemble the average large user.

Companies in this sector currently spend a relatively larger percentage of their budgets on software than the national average and a smaller amount of money on homegrown applications. These firms' proclivity for canned software, says one MIS executive, is a result of the frequency with which they buy and sell business units. Standardized inventory and financial software makes it easier to integrate a new subsidiary into the fold or, for that matter, to present its financial statements to a prospective buyer.

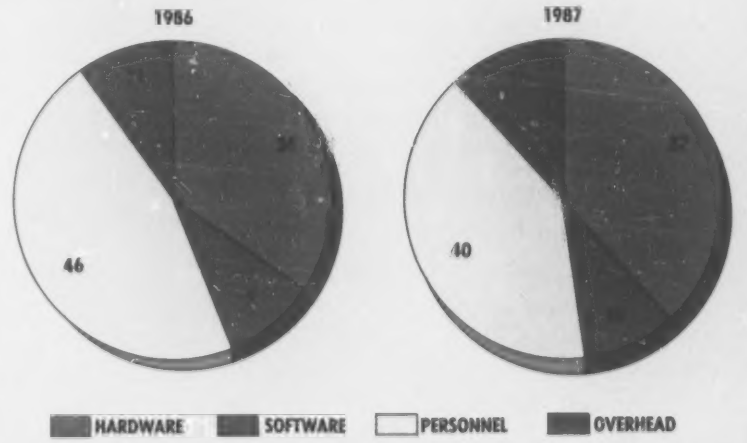
The Top 10

COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
Philip Morris Cos. Inc.	=	25,409	1,478	Dec. 31
RJR Nabisco Inc.	=	15,978	1,080	Dec. 31
PepsiCo Inc.	+	9,291	458	Dec. 28
Kraft Inc.	=	8,742	413	Dec. 27
Coca-Cola Co.	=	8,669	934	Dec. 31
American Brands Inc.	–	8,470	847	Dec. 31
Sara Lee Corp.	=	8,340	241	June 30
Anheuser-Busch Companies Inc.	=	7,677	518	Dec. 31
ConAgra Inc.	=	5,911	105	May 25
Pillsbury Co.	=	5,848	208	May 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

A big piece of the food and beverage sector's software dollars go for packaged software, not homegrown applications.



HEALTH CARE & PHARMACEUTICALS

Tracking Vital Statistics

The MIS department has taken on new importance for this industry. To assist their customers and to foster loyalty, pharmaceutical makers have begun to provide inventory management services, putting terminals in drug stores and sending computer instructors out to visit pharmacists. For health care providers, record keeping assists in caring for patients and in the complex area of billing and government regulation.

Despite the importance of information processing technology in crucial aspects of this industry's daily work, the overall use of computers is relatively light. So large a part of these companies' budgets goes into research (in the case of the pharmaceuticals sector) and medical facilities operations (in the case of health care providers) that information systems costs are overshadowed. As a result, the reported expenditures on computers made by these companies are not necessarily a valid indicator of the overall importance of automation to their proper functioning.

In this sector, computers also figure in off-budget expenditures that are not easily fit into the mainstream. Computer systems help control the production, testing, and packaging of medicines; they also monitor in real time the vital signs of critically ill patients and assist technicians in the analysis of biological samples. Such applications of computer technology are not typical corporate IS.

Compared with other items in their budgets, and to the national average for personnel expenditures, pharmaceutical companies experience personnel costs that are particularly large. There are two apparent reasons for this variation. One is that the applications programs these organizations need are not always available off the shelf, even though they may be built around a core of standard database software. The stringent requirements for data integrity, audit trails, and security exceed similar requirements in other sectors, for this is an industry that not only may be subject to economic sanctions in the wake of a mishap, but legal sanctions as well.

A second source of this sector's unique budgeting pattern is the popularity of minicomputers in both pharmaceutical companies and health care facilities. In addition to the costs associated with the programming and operation of standalone minis, IS managers in this sector must also deal with the difficulties of interconnection.

A typical company in this group is McKesson Corp., San Francisco, whose computing patterns follow the trends in the industry, with one exception: the company's effort to speed applications development is reflected in an even more intense bias toward personnel and away from canned software. By contrast, health care provider National Medical Enterprises Inc., Los Angeles, spends a considerably larger portion of its budget on commercial software packages; industry-provided software is apparently easier to adapt to this company's record-keeping needs.

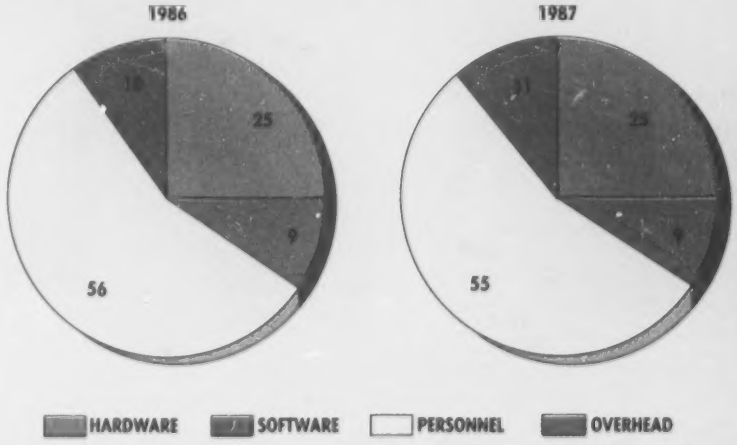
The Top 10

COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
Johnson & Johnson	+	7,003	330	Dec. 29
McKesson Corp.	=	6,285	215	Mar. 31
Baxter Travenol Laboratories Inc.	=	5,543	444	Dec. 31
Hospital Corp. of America	=	4,931	175	Dec. 31
American Home Products Corp.	+	4,927	779	Dec. 31
Bristol-Meyers Co.	=	4,836	590	Dec. 31
Pfizer Inc.	=	4,476	660	Dec. 31
Merck & Co. Inc.	=	4,129	676	Dec. 31
National Medical Enterprises Inc.	=	3,595	118	May 31
Bergen Brunswig Corp.	=	3,066	58	Aug. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

This sector spends a lot of its IS money on personnel, much of it due to custom-made applications programming.



INDUSTRIAL & AUTOMOTIVE

MIS in the Machine Age

The industrial and automotive sector is the most substantial group in this survey, both in terms of aggregate revenue and total IS expenditures. The combined sales for these companies in the last fiscal year were nearly $275 billion, while IS expenditures were nearly $7.5 billion. It's no wonder the computer industry caters to automakers and their industrial cousins.

Hardware purchases come to more than 40% of computing budgets for the heavy industry companies, $3 billion in round numbers. Software represents a slimmer slice of the pie than it does in the overall average, but nevertheless exceeds $500 million a year in purchases.

The vast sums spent by these companies today may look like small potatoes tomorrow as the big three automakers tie their dealers to central computing systems. Even though the dealership minicomputers will be paid for by the independent outlets that sell cars and trucks, the auto manufacturers will become larger and larger service bureaus for their clients, burning up MIPS like tires in a road race.

A big contributor to the heavy iron budgets in this sector is the increasing use of computers to anticipate manufacturing problems and reduce costs. Materials and production time saved during the design phase of a car can return phenomenal dividends when the model is released for production. Similarly, makers of aircraft and other heavy machinery have adopted automated design, simulation, and, to a lesser extent, fabrication technologies in an effort to improve quality and control costs. All these applications require huge algebraic processors, and in some cases have led to the purchase of supercomputers. These companies are also buying vector processing add-ons for their general purpose mainframes to offload work from design departments' overloaded superminis.

General Motors is the biggest user in this sector, with its huge divisional information systems centers at auto plants, its EDS subsidiary—itself one of the computer industry's biggest customers—and its Hughes Aircraft division. But GM is not necessarily the most computer-intensive company in the group. McDonnell Douglas Corp., said to run the largest privately owned computation center in the world, is also a contender.

MIS managers in this sector face unusual challenges because of the sheer size of the operations they supervise. They cannot always look elsewhere for examples of how to handle their heavy workloads, but instead must use their own initiative and break new ground. General Motors, for instance, is still struggling with the issues raised by its proposal for the MAP standard. By all indications, GM cannot realistically expect to link its diverse production systems with central computation facilities in the near future. This temporary setback has not reduced GM's clout: the company is said to have exerted substantial influence over IBM during the evolution of that company's engineering workstations.

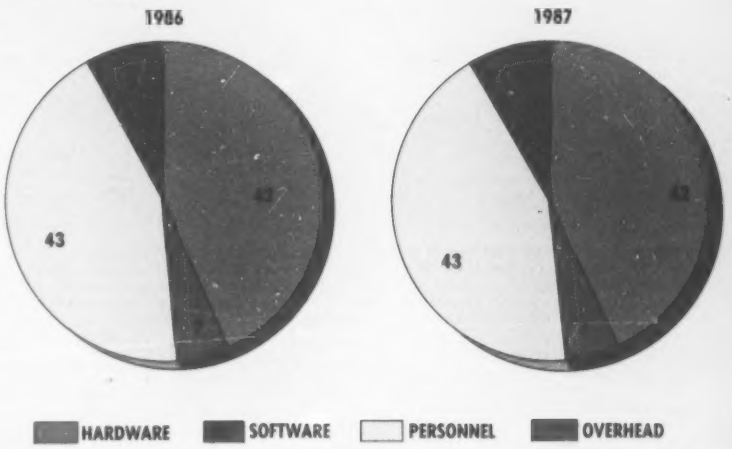
The Top 10

COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
General Motors Corp.	=	102,814	2,945	Dec. 31
Ford Motor Co.	–	62,715	3,285	Dec. 31
Chrysler Corp.	–	22,586	1,404	Dec. 31
Boeing Co.	=	16,341	665	Dec. 31
United Technologies Corp.	=	15,879	73	Dec. 31
McDonnell Douglas Corp.	=	12,661	278	Dec. 31
Rockwell International Corp.	=	12,296	611	Sept. 30
Allied-Signal Inc.	=	11,794	605	Sept. 30
Lockheed Corp.	=	10,273	408	Dec. 28
TRW Inc.	=	6,036	218	Dec. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

The hardware sector of American business is the biggest consumer of computer hardware, both in dollars and in percent of IS budget.



A Premium on Information

The insurance industry puts a premium on computers. The 10 largest companies in this sector together spend $1.7 billion of their more than $100 billion in revenue on IS. Their spending pattern is close to the national average in every category. The insurance industry's leaders invest more than half a billion dollars a year in hardware and more than $150 million in software. In addition to their official budgets, insurers spend another 30% of allocated amounts for off-budget information systems. This puts them near or slightly above the national mean.

Because insurers' budgets seem to follow the national averages in certain areas, it is natural to assume that these large and wealthy companies are generally conservative about computing. Nothing could be farther from the truth. Insurers, with their enormous IS requirements—to say nothing of their desire to make the most of clients' premiums—have figured prominently in pioneering the application of computers to commercial accounting.

Two decades ago, when IBM's first 360 systems were under test at the headquarters of New York Life (a company not quite big enough to make our roster), just one floor below, an RCA Bizmac—a vacuum tube computer—was churning out production jobs. Insurers, then, not only got into computing early, but they have continued to use the know-how they developed over the years. These days, as the big central shops of the industry run gigabyte-sized sorts, their companies' sales forces visit corporate clients with laptop computers.

The largest of the insurers, Aetna, appears to be relatively light on technology compared with its peers, while ITT Corp. is more computer intensive. ITT's standing is owed more to its noninsurance divisions, which resemble other industrial manufacturing companies. But Aetna's situation is harder to interpret, and it may be evidence that the company uses computers somewhat differently from its smaller competitors. Aetna's spending on information systems is still substantial by any standards. Other large insurers, which are somewhat more computer intensive, spend even more on budgeted computing. More typical of the group are Cigna Corp. in Philadelphia and Travelers Corp. in Hartford, Conn., which are heavier on computing than Aetna, in part because they are making strong efforts to put automation behind their productivity plans.

One area in which computers are of growing importance to insurers is in their regional business centers, where the trend is toward installing minis. There is a substantial payoff for insurers if they can implement flexible, responsive systems. Insurers' clients are very service conscious, and the large ones expect policies to be instantly tailored to their changing requirements.

Additionally, the velocity at which funds flow into insurers' bank accounts can make a big difference in profitability. Premium processing bottlenecks impose severe penalties on these companies.

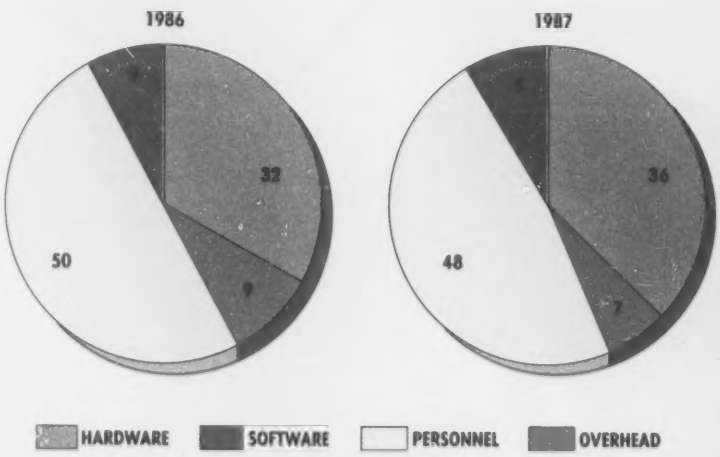
The Top 10

COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
Aetna Life & Casualty Co.	–	20,483	1,043	Dec. 31
Cigna Corp.	=	17,064	817	Dec. 31
Travelers Corp.	=	16,047	444	Dec. 31
American International Group Inc.	=	8,876	657	Dec. 31
Loews Corp.	=	8,626	546	Dec. 31
ITT Corp.	+	7,600	494	Dec. 31
American General Corp.	=	6,160	538	Dec. 31
Transamerica Insurance Co.	=	6,076	268	Dec. 31
Continental Corp.	=	6,002	223	Dec. 31
St. Paul Cos. Inc.	=	3,182	154	Dec. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

The insurance industry leaders invest more than half a billion dollars a year in computer hardware.



Heavy Metal, Light Users

Companies that produce heavy metal goods are much lighter IS users than other industrial companies. Because of the sector's declining health over the past several years, the group's computing needs have not grown along with those of other top shops. But the metals business is still a very big one, and its 10 largest participants pump about $500 million a year of their more than $45 billion in revenue into information systems. As the companies in this group iron out their problems, diversifying operations and selling off unneeded assets, IS managers say their computing facilities will grow anew.

This group's big users spend less of their budgets on hardware and more on personnel than the national average. The contrast is even greater when these companies are compared to other industrial organizations. IS budgets in the metals trade, however, do not encompass the computer-based systems employed to control smelting processes, annealing furnaces, and rolling mills. Ironically, some of the personnel involved with these off-budget systems may well be on the staffing line included in the IS manager's list of expenditures. The actual practices, however, vary from company to company within the industry.

Another factor that makes for significant reported variance (in both budgets and the allocations within them) is the recent trend toward diversification. This change is evident at, and reflected in the new name of, the industry's largest company, USX. USX is a big player in the oil business, running Marathon among other units. It also operates chemical companies and even runs a sizable shipping business used to ferry raw materials across the Great Lakes. None of its non-steel interests, however, are computer intensive. Bethlehem Corp. is one of the most IS-intensive companies in the group, but differs in corporate IS philosophy from its colleagues. "Bessie," as the big steel company is called, is a heavy buyer and developer of software, compared with the group's mean, while Alcoa, more typical of the metals companies, has a relatively larger hardware budget.

Off-budget expenses vary quite a bit across this industry sector. Armco, characteristic of its group in many respects, has been particularly successful at controlling off-budget IS expenditures. Bethlehem Steel, a more intense user of computing than Armco, has even more stringent control of off-budget computer spending. Bessie has gotten unbudgeted computing costs down to a bare minimum, keeping such expenditures flat from 1986 to 1987.

Among the metals group's most important applications is inventory management. With supply lines stretching around the globe and facilities that must run evenly in order to remain efficient, the metals companies need planning and control. The best efforts of their MIS departments, however, cannot always offset the vicissitudes of the world's metals markets.

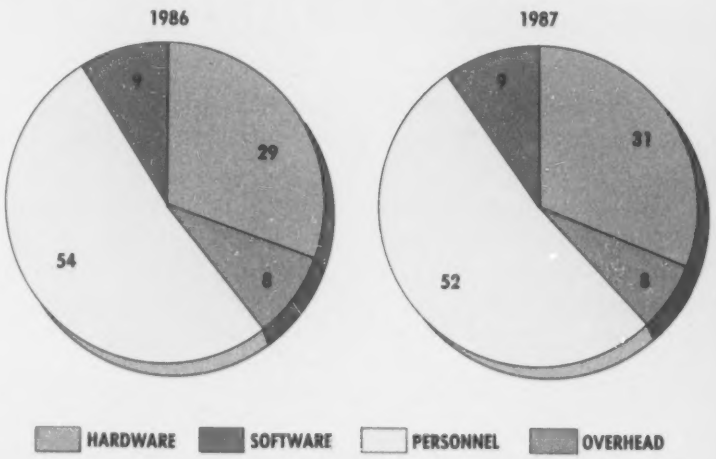
The Top 10

COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
USX Corp.	–	14,938	1,833	Dec. 31
LTV Corp.	=	7,271	–3,252	Dec. 31
Aluminum Company of America	=	4,667	264	Dec. 31
Bethlehem Steel Corp.	+	4,333	–153	Dec. 31
Reynolds Metals Co.	=	3,639	192	Dec. 31
Inland Steel Industries Inc.	=	3,173	19	Dec. 31
Armco Inc.	=	2,641	–472	Dec. 31
Kaiser Aluminum & Chemical Corp.	=	2,222	–33	Dec. 31
AMAX Inc.	+	1,307	14	Dec. 31
Commercial Metals Co.	–	893	14	Dec. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

One of the metals group's most important applications is inventory management.



Oil Fields, DASD Farms

All may not be well in the oil patch, but life is good enough among its largest 10 companies to justify well over $3 billion a year in information systems expenditures. Because other costs remain so high, the petroleum industry devotes proportionately less than other industries to the computing budget. Leaders in this sector divide their IS monies in proportions that are close to the national mean. The IS shops in these companies say they spend a little less on hardware and a little more on overhead than their counterparts in other sectors.

One budget item is larger than in most other nongovernmental areas: storage of data in vast archives. Many of the oil producers have invested heavily in seismic data collection and analysis. They are big warehousers of magnetic tape. At some of these companies, the seismic image processing jobs are so enormous that supercomputers have been brought in to handle the mathematical transformation of raw exploration data. Others in the industry, however, send this work out to service bureaus.

Another application honed to a fine edge by these companies (as it has been by the process industries) is linear programming. Getting the right mix of octane, kerosene, and bunker (a heavy residual oil) from the refinery is a job that cannot be done without computers.

Other optimization programs are used to help manage the movement of raw and finished products flowing through networks of pipelines and carried by fleets of tankers. The oil companies also use computers or outside computer service bureaus to perform a key function that involves large numbers of equations: econometric analysis and forecasting. It is the financial planning done with the aid of computers that sets the pace of exploration, well drilling, and long-term oil contracts.

The largest companies in this group are also relatively light users of computing power, but Exxon and Mobil have such vast empires that their information systems expenses may simply be diluted in a pool of other costs. Nevertheless, there are significant similarities in the budget breakdowns of all the petroleum companies in terms of hardware and software purchases. One area that can increase the hardware budget of a petroleum company is a credit card operation, though this is the case at only a few of the companies in this group. Amoco is more representative of computer users in the oil business, and differs from the group norms only in minor ways: its software and services budget runs on higher octane, compared with its rivals, while its hardware allocation runs a little leaner.

The major participants have a healthy appetite for mainframes, and they seem to have good control over off-budget expenses, which are less than the national norm. The apparent efficiency of oil companies' computing shops may be a by-product of their corporate cultures. Business procedures in oil companies have a tradition of near military precision in their organizational scheme.

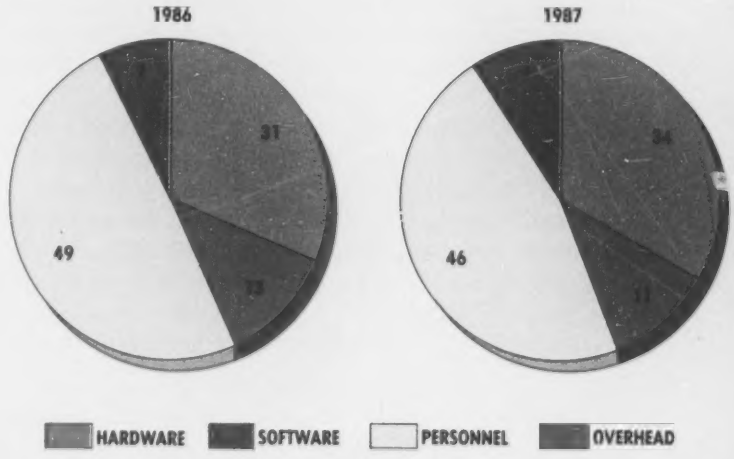
The Top 10

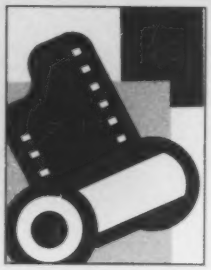
COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
Exxon Corp.	–	71,557	5,360	Dec. 31
Mobil Corp.	–	49,865	1,407	Dec. 31
Texaco Inc.	=	32,600	725	Dec. 31
Chevron Corp.	=	24,351	715	Dec. 31
Amoco Corp.	=	18,281	747	Dec. 31
Occidental Petroleum Corp.	=	15,344	181	Dec. 31
Atlantic Richfield Corp.	=	14,993	615	Dec. 31
Tenneco Inc.	=	14,529	–39	Dec. 31
Sun Company Inc.	–	10,440	385	Dec. 31
Phillips Petroleum Co.	=	10,015	228	Dec. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

A big expense for oil patch IS operations is data storage, raising overhead's bite of this sector's IS dollar.





Continuous Computing

Computing in the process industries evokes images of real-time control centers with Christmas tree-like displays of indicator lights and color graphics. As accurate as this picture may be, those systems represent only a fraction of the computing costs at the largest providers of chemicals, paper, and other continuous production goods.

Corporate computing in this sector is a big business in itself. Aggregate expenditures by the 10 largest revenue gainers is in excess of $1.5 billion. These leading process companies are putting big muscle behind efforts to consolidate data from scattered plants. The result is likely to be significant growth in both raw MIPS and the number of networks among these companies, as well as the consolidation of many off-budget systems under central management.

Process companies are big purchasers of standard software and specialty packages developed by third parties, every year either acquiring outright or licensing program products worth about $200 million. These companies spend, as a result, less of their budgets on homegrown programming. Like their peers in the petroleum business, process industry IS managers have to support extensive libraries of process optimization programs and databases, which are the feedstocks for these packages.

In addition to all the computing required to make the most of their facilities, process companies must keep track of an enormous variety of raw materials and end products. Companies such as Du Pont and Procter & Gamble—also the largest entities in this sector—deal in thousands of different products in hundreds of classifications, with differing packaging, stability, distribution mechanisms, and production constraints.

Many of the process companies are involved in consumer products, though none as completely as Procter & Gamble. Consumer products involve enormous advertising expenditures, but generate profits that more than compensate. The result is that a smaller percentage of the budget goes to production and management functions, including information systems. It is not surprising, then, that P&G is not as big a spender, proportionately, on computers as is, for example, Kodak or Monsanto. (Weyerhaeuser's IS intensity rating may be slighty misleading as the company is well known for conducting a substantial part of its computing at the divisional level.)

As this sector increasingly shifts to on-line order entry and customer support and delivers these services to regional offices and key outside distributors, MIS budgets will rise. The evolution of their IS capabilities will enable the companies in this group to turn over inventories more frequently and to reduce what for some of them amounts to a king's ransom in storage costs. Those companies with experience in real-time process control are likely to have the easiest time coping with the communications aspects of improving their order-shipping-billing cycles.

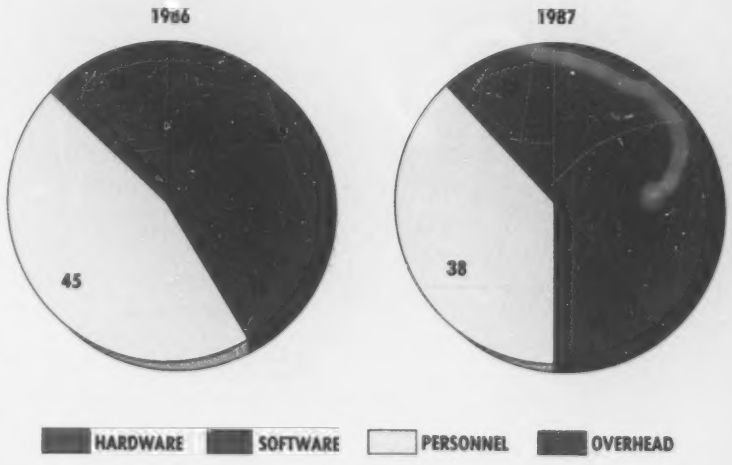
The Top 10

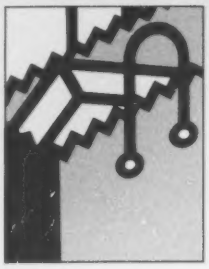
COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
Du Pont	=	27,148	1,538	Dec. 31
Procter & Gamble Co.	–	15,566	709	June 30
Eastman Kodak Co.	=	11,550	374	Dec. 31
Dow Chemical Co.	=	11,113	741	Dec. 31
Georgia-Pacific Corp.	–	7,223	296	Dec. 31
Monsanto Co.	=	6,879	433	Dec. 31
Union Carbide Corp.	=	6,343	496	Dec. 31
Weyerhaeuser Co.	–	5,652	277	Dec. 28
American Cyanamid Co.	=	3,816	203	Dec. 31
Boise Cascade Corp.	=	3,740	102	Dec. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

Aggregate IS expenditures by the 10 largest revenue gainers is in excess of $1.5 billion.





RETAIL

The World in the Store

By the measure of information systems intensity used by DATAMATION to gauge companies' computer use, retailers are barely in the computer age. The nation's 10 largest retailers, with total sales of over $167 billion, may spend a small fraction of this sum on computers, but their IS budgets come to nearly $350 million a year, with more than $125 million of it going for hardware and another $30 million for software.

In addition, several of the large retailers have significant off-budget expenses for computing, sums that may rival budgeted amounts in magnitude. This is because of the way retailers are organized and, in particular, the way they delegate information processing responsibilities. Not one of the companies in this group could manage the logistical aspects of its enterprise without substantial and sophisticated IS shops. These companies can track every penny of a small sale starting at the cash register and following through to the corporate asset management group that maximizes the return on assets. But much of the computing done at chain stores—whether food or nonfood—is done at the individual site or at the regional level. Corporate IS's big jobs are consolidation and the provision of industrywide services, such as customer account management.

The department store chains in this group, like JC Penney, Federated Department Stores Inc., and Dayton-Hudson Corp., usually spend more of their revenue on computing than the supermarket operators, such as Lucky Stores Inc. While K Mart Corp., a department store chain, falls in the midrange when it comes to IS budgets, its philosophy of getting the attention of shoppers apparently was picked up by its own computer professionals, who are adding hardware at a pace more typical of the sector's intensive users.

Department stores, which have a lower rate of inventory turnover than supermarkets, generally provide their customers with more computer-supported services. In addition to credit card processing, the department store chains support telephone ordering services and mail order processing. They also require more information systems for personnel and payroll functions, while supermarkets cater to self-service shoppers.

All of these services, with the associated record-keeping, force retailers to put a larger part of their MIS budgets into hardware than the national average. In addition, the increasingly sophisticated communications links, which enable chain stores to consolidate earnings and inventory information, add to the budgets for iron. Managers of the largest computing operations in the retail sector say that their software budgets—currently below the national average—will rise considerably, although not quite enough to catch up with the mean. This change reflects a move to the use of more standardized packages, a requirement of companies that enter new businesses via acquisitions.

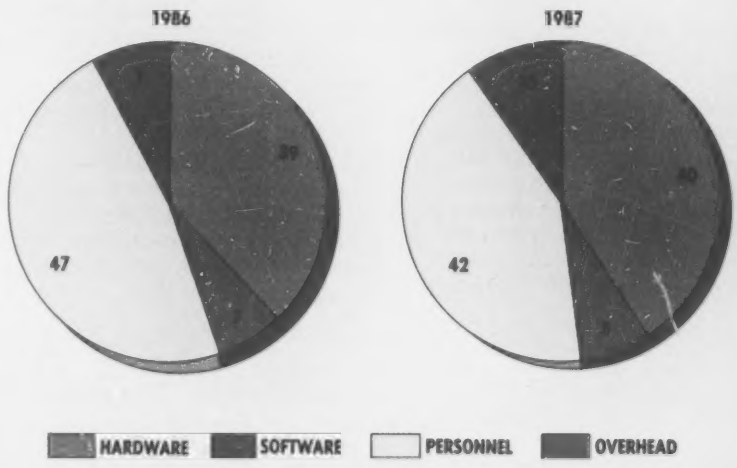
The Top 10

COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
Supermarkets General Corp.	–	44,281	1,351	Dec. 31
K Mart Corp.	=	23,812	570	Jan. 27
The Kroger Co.	–	17,123	56	Jan. 31
Lucky Stores Inc.	=	17,100	138	Jan. 31
J.C. Penney Company Inc.	+	14,740	478	Jan. 31
American Stores Co.	–	14,021	145	Jan. 31
Federated Department Stores Inc.	+	10,512	302	Feb. 1
The May Department Stores Inc.	=	10,328	381	Jan. 31
Dayton Hudson Corp.	+	8,793	284	Feb. 1
F.W. Woolworth Co.	–	6,501	214	Jan. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

The retail sector of the economy is the lowest-intensity computer user in the survey.



TRANSPORTATION

On-Line, On Track, In Air

Retailers must track market conditions quickly. The challenge faced by transportation companies is even greater; for them, quick isn't fast enough. Their customers want to know where things (and people) are instantly. Many companies in the transportation business not only use computers to tell their customers where things are, but also where they last were, where they will soon be, and, in the case of airlines hoping to fill empty seats, where they are not yet.

The dependence on interactive systems by the top companies in this sector has added to the hardware section of their budgets. In addition, the need to develop unique software has raised the costs of personnel. Thus, transportation companies spend less than the national average on packaged software and overhead.

The percentage of corporate revenue that goes for computing among these concerns is somewhat less than the national average. This is not an indication that transportation companies have somehow gotten their interactive databases up and running on the cheap. The relatively light IS budgets reflect the very high cost of running fleets of vehicles and the enormous network of personnel that these companies must support. All told, of their $55 billion in revenue, DATAMATION's 10 transportation companies together spend well over $700 million a year on their information systems.

The most intensive use of computers in this group can be found at Federal Express, which grosses much of its $3 billion annual take in units of $25 or less. Federal's package-tracking capability is the basis of its reputation for good service. Other heavy computer users can be found among the airlines, which can now not only track their own seat inventories, but can also keep tabs on some aspects of rivals' flights.

The IS managers of the travel providers' leading shops are recognized specialists in transaction processing and database maintenance. They are also very much attuned to issues affecting system reliability and availability. As one might well expect, the rail-based transportation companies are the least intensive users of computers in this sector, and the gap between the relative budgets of, say, a Union Pacific and that of an AMR, the parent company of American Airlines, is substantial.

The prospects for increased automation among these companies is bright. Airlines are extending their reservations systems into the offices of travel agents, and their support for other travel-related services is also expected to grow. In the future, airlines may develop profile databases for key customers, much the way car rental firms and some independent travel agents already have established customer "clubs." Ultimately, the airlines may extend their liaisons from the current base—travel industry firms and in-house travel departments at large companies—to smaller corporate users of their services.

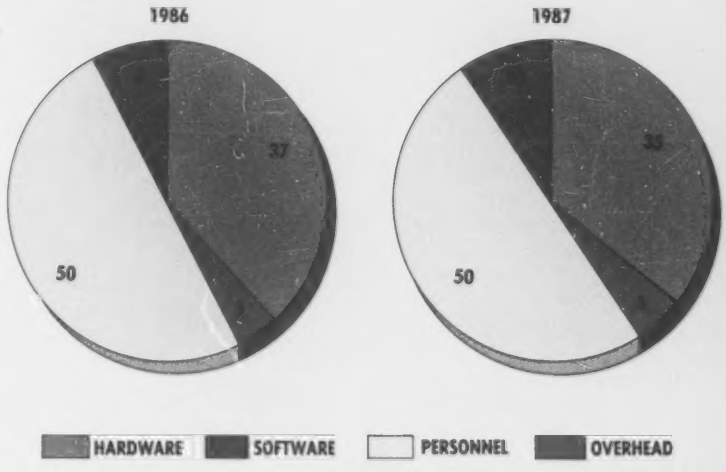
The Top 10

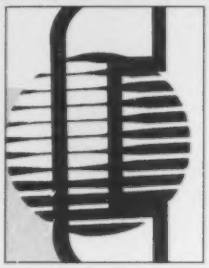
COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
UAL Inc.	=	9,198	12	Dec. 31
Burlington Northern Inc.	–	6,941	–528	Dec. 31
Union Pacific Corp.	–	6,574	–414	Dec. 31
CSX Corp.	–	6,345	418	Dec. 31
AMR Corp.	+	6,018	279	Dec. 31
Santa Fe Southern Pacific Corp.	–	5,631	–269	Dec. 31
Delta Air Lines Inc.	+	4,460	47	June 30
Norfolk Southern Corp.	=	4,076	519	Dec. 31
Trans World Airlines Inc.	=	3,145	–106	Dec. 31
Federal Express Corp.	+	2,606	132	May 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

Personnel for software development at transportation companies consumes a larger than average chunk of IS money.





Dialing for Dollars

When compared with their corporate counterparts in other sectors of the economy, the 10 largest utilities are not power users. The utilities claim that only a small fraction of their more than $121 billion in revenue is spent on budgeted information systems each year—$1.2 billion—even though there is evidence from outside sources that these companies spend twice that amount. As much as a quarter of the total computer-related expenditures of this group are the outlays of just one company, AT&T, which has by far the most installed hardware in the industry.

In addition to spending somewhat more than the average amount on personnel, utilities are big spenders on software, buying outside packages at one-and-a-half times the national average. This makes the utilities group's aggregate hardware budget an undersized slice of a substantial pie. Telephone companies include some of their call data collection equipment in their switching systems budgets, however, and this distorts their accounting self-portraits. Once data are collected, the large utilities go at their billing and analysis in much the same way as other companies with many small transactions do: big mainframes with immense disk farms do the sorting, while banks of laser printers churn out the bills.

Most of the big companies in this group are only separate entities by virtue of the AT&T breakup. While some of these Baby Bells have gone their own way, many still hew to the operational procedures developed when they were part of AT&T. Examples of such companies include Nynex and BellSouth. A similar spending pattern occurs among the telephone-based rivals of AT&T, of which giant GTE qualifies as one of DATAMATION's top shops. This translates into dependence on IBM's mainframe operating environment for large jobs, and the extensive use of minicomputers from other vendors (including AT&T) for smaller ones.

Beyond next year, as the telephone utilities go through a period of laying off some of their employees—in a customer environment that just keeps dialing, piling up big-dollar utility revenues—their budgeting pictures will change. AT&T, for one big example, has already cut staff equivalent to the population of a small city, and is expected to remain trim. Hardware expenditures will grow, relative to those for personnel. Nevertheless, the capital expenditures these companies make for computers will always be tiny compared with the costs of staffing to maintain their networks and switching centers.

Other utilities have a similar need for large outlays that overshadow computer purchases. Southern California Edison, the top shop among electric utilities, puts a lot more of its revenue into power generators than into its computer rooms' power consumers. But its sophisticated billing operation shows that here, at least, IS doesn't hide its light under a bushel.

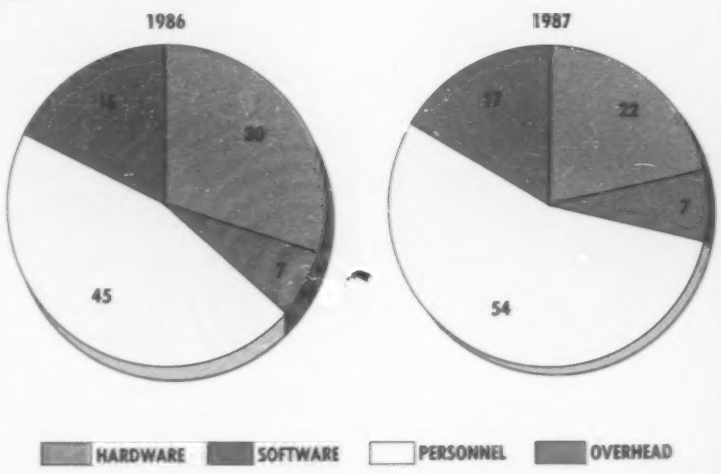
The Top 10

COMPANY	IS INTENSITY*	REVENUE ($ MIL)	PROFIT ($ MIL)	FY END
AT&T Co.	=	34,087	139	Dec. 31
GTE Corp.	=	15,112	1,184	Dec. 31
BellSouth Corp.	=	11,444	1,589	Dec. 31
Nynex Corp.	=	11,342	1,215	Dec. 31
Bell Atlantic Corp.	=	9,921	1,167	Dec. 31
American Information Technologies Corp.	=	9,362	1,138	Dec. 31
Pacific Telesis Group	=	8,897	1,079	Dec. 31
U.S. West Corp.	=	8,308	924	Dec. 31
Southwestern Bell Telephone Co.	=	7,902	1,023	Dec. 31
Southern California Edison Co.	=	5,312	714	Dec. 31

* = means company spends about the same percentage of its revenue on IS as the group mean; + means it spends a larger percentage; – means less.

Distribution of IS Funds by Percent

Utilities spend more of their computing dollars on software than do companies in any other business sector.



Methodology

Based on 1986 revenue figures, DATAMATION selected the 15 largest U.S. companies in each of 12 predetermined industry groups. Two questionnaires requesting detailed information on 1986 and 1987 information systems budgets were mailed to each of the companies.

From the survey responses and other company information, DATAMATION identified the top 10 companies in each of the industry groups and then analyzed information systems expenditures within each industrial sector. Companies within each of those sectors have been ranked according to their 1986 revenues.

Each of the participants was asked to supply total IS budget figures, and total expenditures for functions associated with IS but not included in the IS budget. They were also asked to identify how that budget was allocated among hardware, software and services, personnel, and overhead.

The terms used were defined as follows:

Hardware comprises all computer gear on the IS budget, including data communications. Software and services pertains to all funds allocated for buying software or hiring outside software developers. Personnel encompasses all employee costs for the computing operation. Overhead includes charges associated with the physical plant, including utilities and rent.

Wherever possible, information included in DATAMATION's top shops report was obtained from the companies themselves. When a company did not provide information, or did not provide it in a form suitable for this survey, we have estimated figures, based on investigative reporting and an analysis of industry trends.

In the interest of discretion, and as a courtesy to those respondents who cooperated but who also asked that certain specific facts about their companies be kept confidential, we have not published specific budget line items. Instead, we have provided data on sector aggregates and comparative information on each sector's members. The comparative data are based on total budgeted expenditures and do not include off-budget estimates.

Every effort has been made to include the most significant computer users in each of the 12 categories. Owing to the size of such a comprehensive survey as this, however, some large IS shops inadvertently may have been omitted from our listings. It should also be noted that, because the size of businesses operating within each sector varies to a great degree from industry to industry, some of the companies that failed to make our roster may in fact be larger users than companies in other sectors that did qualify for inclusion in our listings.

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Living with the High Yen

Caught between a weak dollar and a rising yen, information systems suppliers in Japan had their profits squeezed in 1986, despite some healthy increases in local sales revenues. IBM Japan came off worse than most, ending the year with a drop in revenue that left the company in jeopardy of losing its number three position in the DATAMATION Japan 10. Japanese users, however, began to breathe cautious sighs of relief as their budgets again showed an increase after a flat year in 1985.

BY ROBERT POE

The yen rose 29% against the dollar, and Japan's leading information systems suppliers, including IBM, were unable to react quickly enough to protect their bottom lines in 1986.

Despite the economic pressures, the Japanese market for information systems (IS) achieved reasonable growth compared with other industrial sectors last year, registering an estimated 8.6% increase to ¥5,131 billion ($30.4 billion).

The tendency for a few giants to dominate the Japanese market showed little sign of changing. The combined revenues of those companies placing in DATAMATION's ranking of the top 10 information systems companies in Japan hit ¥4.338 trillion ($25.7 billion) in 1986, accounting for a hefty 84% of the total domestic IS market. The four biggest firms pulled in 58% of the business.

Fujitsu again dominated the DATAMATION Japan 10 table, followed by NEC at number two. IBM Japan just held on to third place, staving off the fast approaching Hitachi. NEC took the honor as the fastest growing company in the 1986 ranking (see Figure 1), although it was unable to push Fujitsu out of the top slot as Japan's biggest dp supplier worldwide (see Figure 2).

There were only minor changes in the actual rankings of the Japan 10, despite the economic uncertainty. Toshiba managed to take fifth place back from Matsushita, which entered the DATAMATION Japan 10 table in 1985. Matsushita is predominantly a consumer electronics company, and it suffered from a lack of any flagship IS products that could stop the company's overall revenue slide.

Toward the end of the year, all of the companies suffered to some degree from the contraction of business in the main manufacturing sector in Japan—living with the high yen had begun to take its toll on cash flows. Nevertheless, there was much growth in the nation's finance sector and also among smaller Japanese companies, many of which began to take automation seriously for the first time.

Growth in these sectors helped account for a general easing of Japanese users' data processing budgets, which increased by an average of 9% in 1986, according to figures published by the Japan Information Processing Development Center (JIPDEC).

The JIPDEC survey shows that the Japanese market is emerging from the slump of 1985, when budgets inched up only 1.9%. Even though the 9% increase in 1986 was an improvement over the previous year, the market has not recovered entirely, and there are still questions about the effect that the high yen will have on budgets over the next few years.

Japanese users seemed to prefer trying to squeeze more work out of their old machines than buying new ones in 1986. Although total hardware expenditures were up last year to ¥24.2 million ($143,000) per month, money spent on cpu payments was actually down by 7% to ¥3.45 million ($20,484), and cpu depreciation costs were up 4% to ¥709,000 ($4,200). I/O device expenditures, on the other hand, were up 41% to ¥2.72 million ($16,100), with storage devices down 17% to ¥1.05 million ($6,210). On-line terminals were up 4% to ¥6.3 million ($37,200).

DATAMATION's Japan 10

1986 RANK	1985 RANK	COMPANY	OWNER-SHIP	1986 JAPAN DP REV ($ MIL)	% CHG ($ U.S.)	% CHG (YEN)	1986 TOTAL DP REV ($ MIL)
1	1	Fujitsu Ltd.	Japan	5,457.8	54.7	9.5	6,575.7
2	2	NEC Corp.	Japan	5,122.9	72.8	22.3	6,324.6
3	3	IBM Japan Ltd.	U.S.	3,821.1	38.1	-2.2	49,591.0*
4	4	Hitachi Ltd.	Japan	3,806.7	62.2	14.8	4,728.8
5	6	Toshiba Corp.	Japan	1,979.8	53.8	8.9	2,605.0
6	5	Matsushita Electric Industry Co.	Japan	1,632.9	41.5	0.2	1,944.0
7	7	Nippon Telegraph & Telephone	Japan	1,160.5	51.9	7.5	1,160.5
8	8	Mitsubishi Electric Corp.	Japan	1,102.9	45.8	3.3	1,345.0
9	10	Nippon Univac Kaisha Corp.	Japan/U.S.	985.9	55.6	10.1	985.9
10	9	Oki Electric Industry Co. Ltd.	Japan	668.5	7.3	-24.0	879.6

*Includes parent company revenues

Expenditures for staff, software, and services rose faster than those for hardware. Much of the increase in the "other" category resulted from money spent on communications lines, which at ¥2.22 million ($13,200) amounted to 4.3% of the monthly total.

While the top 10 companies were pulling in the ¥4.338 trillion ($25.7 billion) from their home market, they made another ¥984 billion ($5.8 billion) from exports and sales by their foreign subsidiaries—19% of their combined total dp revenues. Exports, however, played a mixed role in the 1986 results.

On the one hand, Japanese Ministry of Finance statistics show that exports of general purpose computers and peripherals rose 10.3% to ¥1,217 billion ($7.2 billion) in 1986, despite the strong yen. The previous year's increase was a mere 1.7%. This export growth is not as good as it sounds, however. Three companies—NEC, Hitachi, and Toshiba—had higher growth rates in the Japanese market (see Figure 1), which means that they were unable to follow the traditional Japanese manufacturing strategy of growth through exports. Moreover, the 10.3% export hike is a far cry from the heady days of the early 1980s when computer exports grew at rates ranging between 59% and 99% a year.

In a year of a falling dollar, those exports to the U.S. didn't come cheap either. To keep dollar prices the same between 1985 and 1986, a Japanese company had to accept an average of 29% less in yen for the same piece of equipment. This overseas sacrifice battered the bottom line, where profit drops in the 50% range were not uncommon.

So, with growth in the U.S. market stifled because of the shifts in exchange rates, Japanese manufacturers had to fight that much harder over their domestic market. How hard they fought is illustrated by an overall drop in the level of imports into Japan despite the cheap dollar, which made U.S. goods more attractive. Ministry of Finance figures show that computer and peripheral imports actually declined by 21.3% in 1986 to ¥192 billion ($1.14 billion).

IBM Japan's Total Revenues Are Down

Ironically, one of the companies most hurt by export dependence was IBM Japan, which shipped almost 27% of its output to IBM subsidiaries in other countries. Total revenues were off 3.9%, with exports down 8.3%.

Oki Electric, the other big dp exporter, which gets 24% of its business from abroad, did far worse. In addition to depending too much on the export trade, Oki relied heavily for its sales on commodity peripherals—products that are among the most sensitive to price and currency fluctuations.

Oki had a terrible year, and its 24% nosedive in Japanese dp revenues for 1986 pushed it into the bottom position, giving Nippon Univac (NUK) the ninth slot. In fact, Oki barely held on to its place in the table above NCR Japan, which just failed to make the grade.

The most significant slide in revenue, however, hit IBM Japan, which recorded a local sales downturn of 2.2%, leaving its third place standing very vulnerable to Hitachi, which posted a healthy 14.8% increase.

Revenue problems aside, IBM once again seemed to be the center around which the Japanese dp industry revolved in 1986. According to some estimates, by the middle of 1986 IBM's share of the installed base of large mainframes had increased by more than 4% to over 32%, while its 5550 micro had taken second place in business pc sales. The fourth quarter turned sour for the company, however, as the Japanese manufacturing sector, which accounts for some 40% of IBM's sales, cut back drastically on capital expenditures in response to problems stemming from the weak dollar.

Although its sales performance was less than impressive, IBM showed its power in other ways, mostly by flexing its operating systems muscle. In the fall, Hitachi came to a relatively amicable settlement of its OS copyright dispute with IBM. This involved a cross-licensing deal, which, so far, seems to be working well.

Strain On IBM-Fujitsu Relations

Fujitsu's relations with IBM, meanwhile, worsened perceptibly when a copyright agreement dating back to 1983 came into dispute again. That led to further negotiations between the two companies at the American Arbitration Association. Though Fujitsu is coy about the details of the case, the word among industry observers in Tokyo is that the company is now stuck with payments to IBM of around ¥1 billion ($6 million) a month until 2002.

As a result, 1986 saw possibly the most significant differentiation to date between the strategic positions of the world's two leading pcms on the OS front. In most eyes, Fujitsu came out looking far worse than Hitachi, a disadvantage

% CHG ($ U.S.)	1986 TOTAL REVENUE ($ MIL)	JAPAN DP REV AS % OF TOT DP REV	DP REV AS % OF TOT REV	NET INCOME ($ MIL)	1986 JAPAN EMPL	1986 TOTAL EMPL	FISCAL YEAR END
52.6	10,384.5	83.0	63.3	155.7	84,000	89,000	March
68.1	15,034.8	81.0	42.0	200.5	93,346	101,227	March
2.1	51,250.0*	7.7	96.7	4,789.0	20,447	20,447	Dec.
63.9	28,984.4	80.5	16.3	739.1	131,000	161,000	March
61.9	20,135.5	76.0	12.9	230.6	117,600	121,000	March
34.3	29,615.4	84.0	6.5	1,003.4	120,749	135,749	Nov.
51.9	31,265.4	100.0	3.7	928.2	299,600	300,000	March
44.1	12,250.7	82.0	10.9	113.6	62,331	71,479	March
55.6	985.9	100.0	100.0	16.6	4,121	4,121	March
–1.2	2,229.1	76.0	39.4	–14.8	13,991	18,686	March

multiplied by the fact that an estimated 40% of Fujitsu's revenues come from mainframes and related products, as opposed to less than 10% for Hitachi.

The bad news soon reached Europe, where West Germany's Siemens dumped the Fujitsu operating system and began supplying Fujitsu hardware only with its own non-IBM-compatible BS2000 system. Furthermore, the new West German pcm company, Comparex Information Systems, formed by merging the pcm interests of Siemens and BASF, decided that it would concentrate on Hitachi hardware and wean users off of Fujitsu.

While Fujitsu repeatedly insisted it would continue offering IBM-compatibility "to the extent there is customer demand for specific functions," and announced a new operating system that was said to be 95%-compatible, it also tried to disown the pcm label by claiming that it, "does not intend to feature every function provided by IBM as a plug-compatible supplier would."

Operating system jitters were also said to be behind the half-year delay in the first shipment of the M-780, Fujitsu's answer to the Sierra, which had been announced in November 1985.

Comparatively oblivious to these IBM disputes, NEC continued to speed along with its strategy of incompatibility. Last year, NEC made one of its most strategic corporate moves ever in the international dp arena. Together with Honeywell of the U.S. and Compagnie des Machines Bull of France, it helped form a new company based on Honeywell's Information Systems division. NEC took only 15% of the new joint venture, which was less than expected. While NEC says it wasn't interested in a larger stake at the time, the modest investment was probably to avoid any controversy similar to the proposed Fujitsu purchase of Fairchild Semiconductor. The situation wasn't helped by the revelation that a Honeywell DPS 90 sold earlier to the U.S. Air Force Military Airlift Command was in reality an NEC machine using Honeywell software and peripherals. Despite its low-key involvement in the new entity, NEC is expected to be in the driver's seat as the main hardware supplier and eventually to increase its stake to a more substantial figure.

Mainframes Running Unix Are Unveiled

The long-rumored possibility that Japanese companies would finally turn to Unix as a way out of the compatibility dilemma was spotlighted in 1986 when all of the big three—NEC, Fujitsu, and Hitachi—introduced mainframes running Unix in either native or guest mode.

Unix also figured prominently in another attempt to bolster Japanese software independence: the Sigma project. The five-year, ¥25 billion ($148 million) program, sponsored by the government, is aimed at producing on-line systems tools to assist in sophisticated software development. It is supposed to do for Japanese software what earlier projects did for semiconductors and supercomputers—make it internationally competitive by combining the R&D efforts of the government with those of the major companies in the field.

Unix was chosen as the basic operating system around which the various software and hardware tools are being designed. Its first full year of operation was 1986, and significant progress was made toward developing the specifications of the workstations and software productivity tools that will form the backbone of the system.

Some observers suspect that Sigma is more about workstations than about software. According to the Tokyo office of the securities firm Morgan Stanley, U.S. companies now have around 85% of the Japanese workstation market—an enticing target for the local firms. During the year, an impressive number of manufacturers brought out Unix-based workstations, including relatively minor dp players, such as Casio, Ricoh, Sharp, and Sony. As the first commercial versions of the Sigma workstation are introduced—sometime around the end of this year—intense competition is expected to drive prices down over a short period. The result may be low-cost Japanese hardware that will be a prime candidate for export to the U.S., probably running U.S.-developed software.

Even what had been billed as the first all-Japanese operating system, and the powerful 32-bit microprocessor it was to run on—jointly known as TRON (The Real-time Operating Nucleus)—turned out to have a Unix workstation angle. The machines developed for sale in Japan were expected to run one of the TRON operating systems; however, Hitachi and Fujitsu are also working on a version of Unix that will run on the same chip, primarily for machines for export.

NEC Sells Supercomputer in U.S.

At the top end of the product spectrum, supercomputers were at the cen-

ter of a major trade controversy. NEC became the first Japanese company to sell one of the powerful machines in the U.S. when—amidst charges of huge discounts—it placed an SX-2 with the Houston Area Research Consortium. There was no uproar, however, when the company formed a joint sales company with Honeywell, called NEC-Honeywell Supercomputers Inc. So far, the new company has been handling maintenance and service on the original Houston machine, but has made no further sales.

On the home front, the failure of government agencies and universities to buy anything except Japanese-made supercomputers, accompanied by reported discounts of as much as 80% by Japanese makers, became a full-fledged trade dispute by the end of the year. The aggressive overseas and domestic sales tactics of Japanese manufacturers, combined with the government's actions, brought accusations that Japan was targeting yet another U.S. industry for eventual domination.

Trade friction did not hinder developments in the low end of the IS market very much though. Japan made its first major inroads into the U.S. pc business with the successful Toshiba laptops. Most popular was the T3100, which featured advanced plasma display technology that low-cost Asian clone makers couldn't hope to match. The less expensive T1100-Plus supertwist LCD model also did well. These IBM-compatible machines were introduced in January 1986, and by the end of the year some 25,000 per month were being exported, mostly to the U.S. Typically, the Japanese version was not introduced until last December.

NEC also continued to dominate the domestic pc market with an estimated 50% share, led by its 16-bit PC-9801. Its network of 10,000 consumer electronics shops and 200 specialized microcomputer retail stores contributed markedly to its sales success. Fujitsu takes only third place in pcs in Japan, following consumer electronics maker Sharp.

Bright Markets for Domestic Sales

Though the woes of the manufacturing sector put a heavy damper on domestic dp sales, some bright spots remained in the market in 1986.

One sector that showed a strong demand for IS products was the financial industry, which was preparing to meet the challenges of deregulation in the world's financial markets. Not only were Japanese securities firms setting up global information networks as they went international, there was also an explosion of foreign firms setting up or expanding in Tokyo. Fujitsu and IBM in particular benefited from this trend.

The growing demand for networking systems helped the market for telecommunications equipment continue to expand last year. The role of the nominally privatized telecom giant Nippon Telegraph and Telephone (NTT) however, was tempered by political pressures for high-profile procurements of foreign equipment. The digitalization of NTT's networks gets most of the credit for an 80% increase in the sales of digital switching equipment in 1986, according to securities firm Vickers da Costa. The increase for 1987 is estimated to be 85%. NEC, NTT's traditional supplier, is the telecom leader, with Fujitsu in second place.

There was an increased demand from small companies too, especially the suppliers of the major manufacturers, which are traditionally the first to feel the squeeze when Japanese exports get tight. Ironically, this segment became a more promising growth area than the larger manufacturers in 1986, as automation became an absolute necessity for survival.

The small company trend is of benefit to NEC in particular, as the leading supplier of smaller business computers. The trend also helps Toshiba, which does not manufacture mainframes, but has concentrated on midsize distributed processors. This growth in demand is reflected in Japanese user budgets during 1986.

These user budgets are expected to increase again in 1987, but it is not yet clear just how much of a debilitating effect the high yen will have on the flow of cash from the corporate coffers to the IS departments in Japan.

One of the most significant effects of the drastic increase in the value of the yen in 1986 may have been to upset some long held notions about the superiority of Japanese manufacturing in general. The huge drop in corporate profitability resulting from lower overseas revenues suggests that a large part of Japan's competitive edge in the past may have stemmed from macroeconomic structural advantages. As such advantages began to disappear, Japanese manufacturers reacted much as their American competitors had years earlier, cutting costs at home and moving as much production as possible overseas.

Methodology

The 1986 Japan 10 survey was compiled exclusively by DATAMATION from information culled from our in-house database, which tracks the results of over 200 companies worldwide. All revenue and earnings figures have been adjusted to calendar year calculations and converted to U.S. dollars using the OECD average exchange rate for the year.

For a specific definition of data processing-related revenue, see "The DATAMATION 100" methodology, June 15, p. 37. ■

FIGURE 1 Fastest Growers

JAPAN 10 RANK	COMPANY	% CHG (YEN)	JAPAN DP REV ($ MIL)
2	NEC Corp.	22.3	5,122.9
4	Hitachi Ltd.	14.8	3,806.7
9	Nippon Univac Kaisha	10.1	985.9
1	Fujitsu Ltd.	9.5	5,457.8

FIGURE 2 Leading Japanese Dp Companies

	COMPANY	WORLDWIDE DP REV ($ MIL)	% CHG ($ U.S.)	% CHG (YEN)
1	Fujitsu Ltd.	6,575.7	52.6	8.0
2	NEC Corp.	6,324.6	68.1	19.0
3	Hitachi Ltd.	4,728.8	63.9	16.0
4	Toshiba Corp.	2,605.0	61.9	14.6
5	Matsushita Elec. Indus. Co.	1,944.0	34.3	–4.9
6	Mitsubishi Elec. Corp.	1,345.0	44.1	2.0
7	Nippon Telegraph & Telephone	1,160.5	51.9	7.5
8	Seiko Epson Corp.	1,035.7	91.2	35.2
9	Nippon Univac Kaisha Corp.	985.9	55.6	10.1
10	Ricoh Company Ltd.	933.8	26.6	4.1